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Earth Science

Rockhounds' NATIONAL Magazine

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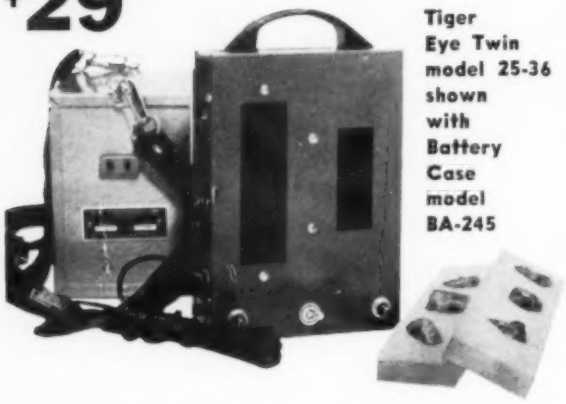

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Earth Science

Volume 13
No. 6
$2.50 a Year

Official Publication of the Midwest Federation of Mineralogical Societies.

EARTH SCIENCE PRESENTS FOR DECEMBER, 1960

Cover ..... Christmas Tree Salutes the Glaciers

Cover Photo by Maynard Leatsler: Tiny Christmas Tree standing on the brink of Jackson (Hole) Lake, looks across the water and salutes the snowclad Teton Mountains in the background. Taken in Wyoming, 20 miles below the 'South Gate' of the Yellowstone National Park.

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Editor's Memo Pad

CONFIDENTIALLY ! !
What Goes Here?

YES! Ye Editor has his problems, too, and one of them is to be able to decide just what type of material is suitable or appropriate to publish in a magazine such as ours—and on the other hand, what is so irrelevant that it cannot well grace our columns.

Rockhounding, as now practiced, is a tremendously diversified hobby, and one is often surprised at the very unusual, even exotic interests which certain individuals have developed. One good friend, we learn, specializes in fluorescent woods and has a splendid collection which displays these phenomena most beautifully —and you may rightfully inquire, just where do minerals come into the picture?

Surely, woods are from the soil (mineral substances), but pray tell why do some woods fluoresce and others do not at all, when both have grown in the same or identical soils. Plants are food chcosey, and perhaps have some innate intelligence which is beyond our comprehension. Yes, some plants do have a primitive nervous system, it has been suggested by those who should know.

Another friend travels far and wide collecting conodonts, and has already found several species new to science, and as yet we are not even sure what these creatures are or what they are like. We might enumerate yet other eccentricities in the collecting world, and perhaps you are familiar with a few queer ones yourself.

No harm will be done by listing a few of the more common topics in which we do have a wholesome interest, and upon which we strive, insofar as our space will permit, to keep our readers well informed. Beginning with the broad subject of minerals themselves, which are really at the bottom of all of our interests, we may break it down into various divisions such as reference minerals, mineral ores, gem minerals, crystals, rock forming minerals, and more generally vulcanism (volcanoes), seismology (earthquakes), archeology (Indian artifact), speleology (cave formations), to name only a few.

Some may go in for large showy pieces, even museum size—while others may prefer smaller pieces which they may keep in drawers. Thumbnail collections and micromounts are also popular, as well as thin sections. On the other hand large numbers of our mineral fans prefer to cut or polish stones. The lapidary arts, too, have numerous divisions.

It would seem then that we have an almost unlimited field of interests to draw from, and should any of our readers desire articles upon some special subject in which they may be interested, we would certainly appreciate hearing from them.

Constructive criticism is also always welcome, as we cannot possibly know what is in your mind unless we hear from you. Even our advertising, we feel, is interesting, and often quite instructive, and Club News and Book Reviews help keep us well informed on what goes on in the Earth Science world. Adieu.

* * * *

Coming Up For February

We are all looking forward to reading the second installment of "The Art of Fashioning Gem Stones," by J. Daniel Willems, following his first article published in our recent August issue. Few authors in the country are so well qualified as Dr. Willems to write upon this subject.

(Continued on next page)

Ruth Culp Zeitner, who in the past has contributed many excellent articles to our pages, now writes most interestingly upon the "Recovery of Ree Indian Relics," from the valley of the Missouri River in the Dakotas, which soon will be inundated by the flood waters of the great dam which is being constructed across the valley by the Federal Government for irrigation, flood control, and power purposes.

Other fine articles soon to appear will be one by Burke Smith on "Stonehenge —England's Noted Relic"; "An Easy Method of Making Solderless Jewelry," by Doris E. Kemp; "Accessory Minerals of the Keokuk Geodes"; and "Grand Mosaics of the Iowa State Capital."

* * * *

RIP RAP

When Prime Minister Diefenbaker of Canada concurred with the United Nations majority recently in refusing to brand the United States an aggressor, he called attention to the 3,000 miles of boundary between the two countries which are unmarked by a single fortification. The exchange of minerals between collectors here and in Canada, we believe, is one small link in the chain of friendship which binds us to the land of the Laurentian Shield.

You will note that Canadian suppliers occasionally use our pages to call attention to their offerings. We were particularly pleased that Northern Minerals and Silvercraft Supply of New Liskeard, Ontario placed their very first piece of classified advertising, on Canadian native silver, with us. Ottawa Valley Gem Shop of Ottawa has advertised richly-colored labradorite and amazonite from time to time. Luke Ladouceur of Bancroft, Ontario has written us about his unusual Iceland spar.

Many requests for sample copies and subscriptions, on the other hand, come to us from north of the border. In this way our U.S. advertisers reach their Canadian neighbors.

Lottie (Mrs. Walter) Loy of Hot Springs' House of Crystals adds a benediction to the note accompanying her ad checks after each issue. We couldn't find a better ending for RIP RAP's little Christmas contribution to the spirit of good-will. So "God bless you and yours!"

Letters are Interesting

More Upon Pearls:

Wauseka, Wisconsin

Dear friend Wilson:

Yes! I do like the new cover on Earth Science Magazine and think it has much more eye appeal than the old. I have always enjoyed Earth Science, and your article on pearl fishing was very good. I could add that one of the biggest buyers of pearls is still living in Prairie du Chien, (Wis.) and has told me many things about the trade, even as to how a pearl is peeled and the instruments used in doing it.

Sincerely,

Mosaic Museum. Joe Phetteplace.

* * * *

New Tumbler Idea:

St. Paul, Minnesota

Earth Science Editor:

Knowing that you seem always glad to keep your readers well informed upon what is going on in the lapidary field, I am writing to tell you that our new "Tumblal" rock tumbler has met the approval of both professionals and hobbiests and we're getting compliments on how quiet it is in operation, its high capacity, and its low cost. We're delighted, of course, because we put a great deal of time into designing, engineering and testing the "Tumblal" so that it would be, in all respects, a very satisfactory machine. The fact that our open top permits easy inspection of the progress of the grinding, and for adjustments in grit, water, angle and speed, is a feature greatly appreciated.

Yours, Karl Larson

* * * *

Special Request:

Downers Grove, Illinois

To Earth Science Readers: It has occurred to me that perhaps many of you may have at some time or other made lapidary jewelry-craft of your own original design which your friends would be interested in hearing about.

If so, and you will mail me a sketch or a picture, or perhaps an original, I will be only too glad to evaluate its artistic character critically, and if it appears to be of sufficient originality or attractiveness, we might possibly like to use it to help illustrate some of our future articles of "lapidary art" to be published in Earth Science—of course giving due credit to the originator of the idea. Your correspondence upon this subject is solicited.

Donnafred Hoff, Art Editor

Coesite Discovered in Famous Bavarian Crater

COESITE, the dense and highly stable form of silica not known to occur naturally on earth before it was recently collected and identified by Geological Survey scientists at Meteor Crater, Arizona, has now been recognized in rock specimens collected near the rim of Germany's famous Rieskessel in Bavaria.

The original find in Arizona was considered by Dr. Eugene M. Shoemaker, Survey geologist, to be conclusive evidence that the crater was the result of a collision between the earth and a sizeable meteorite. It gave considerable weight to his paper before the recent meeting of the International Geological Congress in Copenhagen, Denmark, in which he discussed the impact mechanics of the earthshaking crash which geologists say occurred sometime during the Quaternary Period of Geologic Time, or within the past 1 million years.

The Rieskessel is an immense depression some 17 to 18 miles in diameter consisting of a chaotic jumble of broken granite and Triassic and Jurassic sediments beneath a cover of Upper Miocene fresh-water deposits. It has been greatly modified by erosion and sedimentation but according to Dr. Shoemaker, it shows stratification of debris similar to that in Arizona Crater, indicating the forces originated at a central point. Within its confines are several communities and the old walled city of Nördlingen. In some places the crater walls have eroded so much the crater rim is scarcely discernible.

Enroute to Copenhagen, Dr. Shoemaker visited the Ries and its renowned "Kessel" or crater. While there he was struck by the similarity in appearance between specimens of glass and "shocked granite" he collected from what has been called "suevite," and the "sheared sandstone" of Arizona in which coesite was first found. Samples were sent back to Washington and examined in the Geological Survey's geo-chemical laboratories by mineralogist-geologist Edward Chao. Dr. Chao again made X-ray studies similar to those made on specimens from Arizona, and was able to report that these new specimens from Germany also contain coesite. This means there are now two places known on earth where coesite occurs in nature.

Unlike Meteor Crater, Arizona, the Ries dates back to the Miocene epoch, of some 12-25 million years ago. This makes it the first such crator to be identified in the Prepleistocene record. One of the strongest arguments against acceptance of a meteoritic origin for the Ries crater has been the complete absence of any concrete evidence of a meteorite having struck the earth before the Age of Man. There is no doubt about its antiquity, for rubble on the floor of the Ries Plain is overlain by lake sediments definitely identified as late Miocene.

Coesite was produced from quartz for the first time only a few years ago by Dr. Loring Coes, Jr., who was one of many scientists investigating the effects of high temperatures and pressures upon various minerals. Because of the extremely high pressure necessary for transposing quartz into its more dense phase known as "coesite," it was postulated that it could be formed in the earth naturally, only at great depth. When it failed to turn up in the diamond pipes of South Africa or in other silica minerals subjected to severe shock, investigators predicted it would never be found as a natural mineral. Its discovery in material from the Arizona crater came as a distinct surprise to the scientific world.

Press Release, U.S. Geological Survey

New Meteorite Laboratory

WE are pleased to announce the establishment, effective July 1, 1960, of the American Meteorite Laboratory, as successor to the American Meteorite Museum, formerly operated by Dr. H. H. Nininger at Sedona, Arizona, who has contributed many articles to the pages of EARTH SCIENCE magazine.

The American Meteorite Laboratory will:

1. Carry on a continuous search for new meteorites through the free examination of suspected meteorite samples, conducting field investigations where indicated and purchasing authentic meteorites at fair prices.

2. Distribute to scientists, institutions, and collectors meteorite specimens, books on meteorites, and a variety of other materials covering all phases of the subject of meteoritics. Catalogs of these materials, as well as of our unique meteorite jewelry, are available upon request.

3. Promote our nation's defense and conquest of space by furthering in every way possible the recovery and study of meteorites and related phenomena.

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The Mesabi and Its Minerals

By RICHARD N. LAKE

THE first high grade iron ore on the Mesabi range was discovered near what is now the Mountain Iron Mine on November 16, 1890. Since then about two billion tons of iron ore have been removed from over 250 mines on the range.

The Mesabi range lies northwest of Lake Superior. The range occupies the middle slopes of the south flank of the Giant's Range, a low chain of hills extending from a point north of Grand Rapids to Birch Lake at the St. Louis County-Lake County line. In the east the summits are 400 feet above the general level of the surrounding country. The elevation of the crest diminishes westward, and beyond Grand Rapids the entire ridge is buried by thick glacial deposits. The length of the Mesabi range is about 120 miles and its width varies between two and ten miles. Excluding the parts exposed by mining, most of the Mesabi range is blanketed with glacial deposits between 20 and 500 feet thick.

The Mesabi range rocks, or the Animikie group of the Later Pre-Cambrian, as they are called by the geologists, consist of three formations. Because the Animikie sediments strike about N. 75° E. and dip 6-12° SE, the exposure of the lower formation is the most northerly and the middle and upper formations are to the south of it. The Pokegama formation is the lower rock formation. The Pokegama formation consists of quartzite with occasional sports of quartz-mica argillite and a basal conglomerate of pebbles and boulders derived from the underlying formation. The formation, which outcrops in many places, is quarried for building stone quartzite north of Hibbing.

The middle formation, known as the Biwabik iron-bearing formation, is the most important to the mineral collector. All of the minerals listed in this paper are found in the Biwabik formation. All rocks of the iron formation, other than oxidized ore bodies, are called taconite and make up about 90% of the Biwabik formation. Taconite has an iron content that varies between 15% and 35%. Taconite consists of admixtures of minerals which belong to four chemical groups, as listed here in order of decreasing abundance: silica (chert), iron silicates (minneso-

Mr. and Mrs. Shepard of Bovey, Minnesota looking over the goethite bearing waste rock in pit near Chisholm.

Many of the minerals discribed in this article can be found in taconite ridges like this one near Coleraine, Minnesota.

taite, stilpnomelane, greenalite), iron oxides (magnetite, hematite), and carbonate (siderite, calcite, dolomite).

Taconite can be classed as either a massive, granular, "cherty" type or thin-bedded, "slaty" type. The following table shows the stratigraphic sequence of the divisions of the Biwabik formation.

	Thickness in feet
Upper Slaty division	0 to 170
Upper Cherty division	80 to 250
Lower Slaty division	0 to 250
Intermediate Slate	0 to 40
Lower Cherty division	20 to 400
Total	350 to 800

The magnetic taconite which is concentrated for ore comes from the Lower Cherty division.

The high grade ore deposits occur only in restricted zones where most of the silica has been leached out of the taconite by water circulating through cracks and fissures in the rock. Direct shipping ores have an iron content between 50% and 65%. The "paint rock", a red and white banded horizon with a high clay content, is decomposed intermediate slate.

The Virginia is the upper formation and is found to the southeast of the Biwabik formation on the Mesabi range. This formation consists largely of argillite. Although the surface contact between the Virginia formation and the Biwabik formation has been well mapped by drilling, few outcrops of the Virginia formation are known.

Most of the Animikie sediments are essentially unmetamorphosed, but the Duluth gabbro has recrystallized the iron-bearing rocks of the easternmost Mesabi. The gabbro cuts diagonally across the Animikie group, obliterating all the sediments for a distance of fifty miles between Birch Lake and a point ten miles west of Gunflint Lake on the Gunflint range.

Scattered deposits of thin Cretaceous conglomerate and shale lie with angular unconformity upon the edges of the Animikie beds of the Mesabi range. This formation, called the Coleraine, is exposed beneath the drift in mines from Coleraine to Eveleth. The conglomerate which was derived from the underlying iron formation is often a high grade ore. Highly polished pebbles of goethite and hematite are often found in the conglomerate. The Coleraine fossils are dominantly Mollusca, with at least 11 new species. A great many shark and other fish teeth have been found in the vicinity of Calumet and Coleraine. Carbonized wood is common and occasionally pyritized wood is found.

A block of vein goethite (to the right of hammer) in the bottom of an open pit near Chisholm, Minnesota.

The following list of minerals that can be found on the Mesabi iron range, although not complete, comprises minerals of interest to the collector.

ARAGONITE—Specimens have been found in the ore deposits.

CALCITE—Reported as crystals in vugs in the Biwabik formation.

COPPER—Native copper has been reported from a fissure in the ore in the Wanless mine near Buhl.

CROCIDOLITE — Fibrous blue clumps of this mineral have been found northwest of Aurora near the St. James mine. It was in the metamorphosed Upper Cherty taconite near the Aurora sill, a soda-rich intrusive. When mining exposes more of the sill, blue tiger's eye, which contains crocidolite and occurs in similar formations in Africa, may be found.

A diamond drill working in an open pit mine near Bovey, Minnesota. A common sight everywhere on the Iron Range.

DOLOMITE—This mineral has been found in vugs in the ore and taconite.

GARNET—Many small, well-formed red crystals are found in the conglomerate at the base of the Biwabik formation on the easternmost Mesabi range.

GOETHITE—This mineral is commonly found in extensive layers in the ore bodies. It is usually called "limonite" or "brown ore" by the miners. Most of the goethite is found in earthy, impure layers. Fine specimens of goethite in reniform, botryoidal or stalactitic masses are found on the Mesabi range. Sometimes hard black masses of tumbling grade goethite are found. Most of the tumbled gemstones from the Mesabi called "hematite" are goethite.

GREENALITE—Three rare iron silicates make up a large part of the taconite: minnesotaite, stilpnomelane, and greenalite. Greenalite is dark olive to dark greenish brown in color. Greenalite's formula may be written as $(OH)_{6-x}(Fe'', Mg)_{6-x}Fe'''_xSi_4O_{11}$ $_xH_2O$. The mineral may be classed as an iron serpentine.

GRUNERITE—This mineral is common in the metamorphosed taconites west of Aurora. It is either yellow or colorless and usually occurs with quartz and magnetite. Most grunerite occurs as elongated grains up to 0.2 millimeters long. The chemical formula for grunerite is $(OH)_2Fe_7(Si_4O_{11})_2$. Other rare amphiboles between actinolite and grunerite in composition have been observed in the metamorphosed taconites.

HEMATITE—Impure hematite of the variety martite forms the bulk of the iron ores on the Mesabi range. The highest grade ore is usually a dull blue-black martite and is very earthy. Some specular hematite has been found, but it is not common.

LIMONITE—Most of the ore that is called "limonite" or "brown ore" on the Mesabi range is cryptocrystalline goethite containing admixtures of water and other materials. "Turgite" is a mechanical mixture of hematite and goethite.

MAGNETITE—The chief iron oxide in taconite is magnetite. It occurs in fine grains disseminated through the rock. It decomposes to martite in the ore bodies. Layers up to six inches thick are found on the easternmost Mesabi. Large crystals of magnetite are found in conglomerates in the ores between Hibbing and Mt. Iron. The largest crystals are over two inches across. Beautiful groups of low-temperature octahedrons with marcasite have been found in Cretaceous conglomerate in the Judson mine near Buhl.

MANGANITE—Prisms up to several millimeters long are found in cavities in the high manganese ores.

MARCASITE—This mineral is found in fissures in the ore bodies and in conglomerates overlying the ores.

MINNESOTAITE—One of the iron silicates (see greenalite, stilpnomelane) which make up a large part of the taconite. Minnesotaite is the most common. In some samples of cherty taconite it makes up 90% of the rock. In these specimens it has a light greenish gray color. Minnesotaite is translucent and has a waxy to dull luster. If it is not intergrown with quartz, it is very soft and granular. Its formula is $(OH)_{22}(Fe'', Mg)_{22.3}[Si_{30.4}(Al, Fe''')_{1.4}]O_{74}$.

PYRITE—"Fool's gold" is often found on the Mesabi. Cubes of pyrite up to one inch in size are found in slaty taconite.

QUARTZ—The variety chert is the predominant mineral in unaltered taconite. Quartz veins, many over a thousand feet long are common in the ore bodies. Small, well-terminated crystals are often found. Exceptionally large quartz crystals, some of them fairly clear, two to four inches in diameter, have been found. Polishing grade jaspers are often found. Algal jasper, a multi-colored chert with a "contorted banding", is a popular polishing material. Lake Superior agates, often of exceptional size or quality, are found in the red glacial drift overlying the Biwabik formation.

RHODOCHROSITE—A few specimens have been found with small crystals or botryoidal crusts.

SIDERITE—Cream-colored siderite is found in the ores of the Eveleth area. It is crystallized "cross-fibre" fashion in veins as wide as two inches.

STILPNOMELANE—One of the iron silicates (see greenalite, minnesotaite) that make up most of the cherty taconite. Stilpnomelane is found as plates or folia as large as several millimeters in diameter in quartz veins in taconite and ores east of Hibbing and in the Embarrass River diversion channel east of Biwabik. Stilpnomelane varies in color between golden brown and olive green. Its formula is: $(OH)_4(K, Na, Ca)_{0-1}(Fe, Mg, Al)_{7-8}Si_8O_{23-24}$.

WAD—A mixture of manganese ores, including pyrolusite, psilomelane, and manganite, with iron oxides is often found in the ore bodies. This ore is called "wad". Manganese and sometimes iron dendrites are often found on the surface of exposed taconite.

Many of the minerals listed above can be found by the collector from outside the range if he has a few weeks to look for them. Mining activity often removes whole deposits of fine specimens in a short time. Because of this the listing of the locations where the various minerals are now found would soon be worthless. The collector who has not been on the range before may contact a member of the range's Mesabi Rock & Mineral Club for information on collecting spots and collectors to visit.

The collector should obtain permission from the mine superintendent before entering any mine. A complete list of mines, mine owners, and chief personnel is given in the *Mining Directory Issue* by Henry H. Wade and Mildred R. Alma. This bulletin, which is published each year, is available from the Director, Mines Experiment Station, University of Minnesota, Minneapolis.

The mining companies spend much time talking about and working on safety. The loose rocks in the mines and on the waste dumps cause many accidents. One accident and it may be no more collecting for any of us! It has been said that "every specimen removed from the mines is one saved from the blast furnaces." If the collector remembers this and heeds the warnings posted in the mines for his safety, he may spend many enjoyable hours collecting in the pits and on the mine dumps of the Mesabi iron range.

GEOLOGY—An Infant Science

By JOHN S. ALBANESE

IT IS somewhat of an enigma that thousands of years ago, man's curiosity and inquiry concerning the world around him was first directed toward the heavens and not to the ground beneath his feet. Observations of the planetary revolutions and the calculations concerning their movements across the sky were developed to a high degree of accuracy by the priests of ancient Babylonia. The ancient Greek philosophers knew that the earth was round. They gave as proof the curved shadow of the earth upon the moon during an eclipse. But this observation seems to have been lost sight of until modern times. Strange as it may seem, of all the physical sciences, geology was the last to emerge.

Mineralogy as a science began in the middle ages when alchemists worked with flasks and crucibles in the vainglorious desire to transmute base metals into gold. Alchemy won to its service men of culture and attainment from every race and clime. The early devotees of alchemy cared little for the material things; they were inspired by a vision of man made perfect—of man freed from disease and the limitations of mental faculties. Greek philosophers discovered that sulphuric acid dissolved metals, and thus the early rudiments of chemical theory. The Roman emperor Caligula instituted experiments for producing gold out of orpiment, the sulfide of arsenic with a beautiful golden-yellow color.

Alchemy flourished in Arabia from the 8th to the 13th centuries, and was carried by the Arabs into Spain from whence it spread to all parts of Europe. Later, it was chiefly the monks who preoccupied themselves with alchemy. The English monk Roger Bacon believed it was possible to transmute base metals into gold. Eventually the alchemists of Europe became divided into two classes. One class was composed of men of diligence and sense, who devoted themselves to the discovery of minerals, chemical compounds and chemical reactions. The other class took up the fantastical side of the older alchemy. Secret cults followed, and a practice was developed based on imposture and fraud, from which the prevailing notion of alchemy is derived.

Modern civilization rests upon a foundation of chemicals and the metals. These substances come initially from nowhere but the rocks. Every particle of matter in your automobile for instance comes from the rocks. All the chemical elements used in the laboratory come from the same source—the rocks. The chemist may combine these elements which are found in the rocks into compounds. He may even synthesize artificial diamonds and other gem stones and likewise improve the quality of metals and alloys. He may even extract petroleum from hard rockshale. These same chemical processes however have been going on in Nature's laboratory since the beginning of time on earth. The entire mineral kingdom is indeed one vast chemical laboratory, measured only by the extent of the earth itself.

The mineral kingdom invites the attention of everyone of us to study it. Mineralogy unfortunately is seldom taught in grade or high schools, and young people with inquisitive minds and the spirit of adventure have little opportunity of discovering the fascination of an ideal hobby. Teachers we feel should stress the importance of cultivating one or more hobbies early in life, which can be progressively pursued until such stage is reached where they too may be able to help solve some of Nature's great mysteries. The more we learn, the more we realize how little we know of Nature's hidden secrets.

Rocks and minerals are not merely

things to collect and admire, for it is true that when these objects are studied diligently they enable us to read the long panorama of the earth's history as it is written in the rocks. We owe our present knowledge of the earth's long history, however meagre it may be, to the students of Earth Science—working in all of its numerous branches.

EDITOR'S NOTE: The foregoing interesting notes are excerpts from the *preface and introduction* of a book written by John S. Albanese, now in process of publication.

MAN'S EARLY USE OF METALS*—The use of metals can be traced back thousands of years in the history of mankind. The first metals collected and used by man were those which we now refer to as being noble; i.e., metals which show only little tendency to combine with other, nonmetallic elements such as oxygen and sulfur. Among these metals are gold and silver, which occur commonly in the native state in nature. Copper is somewhat less noble, but sufficiently so that it occurs sporadically in the elemental form in nature. Moreover, this metal can be reduced with relative ease from its common ores such as oxides and sulfides. It is therefore not surprising that primitive man was able to extract copper from copper minerals. At first this undoubtedly happened accidentally when pieces of copper minerals were used as stones to enclose campfires. Gradually these "smelting operations" developed into an art, and not much later primitive man also discovered that it was possible to "burn out" iron from its ores in a similar way. Although natural occurrences of native iron are known, this element forms much more stable compounds (oxides, sulfides) than those previously mentioned. Hence the extraction of iron from its minerals represented a great step forward in man's conquest of nature.

The methods used for iron extraction remained fundamentally the same for centuries, but gradually the efficiency of the operation was increased as the "hole-in-the-ground" furnaces were replaced by charcoal-fired hearth furnaces erected on high elevations in order that wind might assist combustion. As bellows later became known, blast air was used to supplement or replace natural draft. From these "bloomery" furnaces the first blast furnace originated in the Rhine province in Germany in the fourteenth century, and from this have developed the gigantic blast furnaces of our present day iron and steel plants.

With high-grade iron ores becoming more scarce and competition more keen, an intensive search is now in progress for new and more efficient methods of iron production. Most of these fall in the category of direct reduction processes where the product is referred to as "sponge iron." The science and technology of metallurgy have now advanced to the stage where new processes can be examined critically from a scientific point of view before practical operations are initiated.

*Dr. Arnulf Muan,—writing in "Mineral Industries", Bulletin of Mineral Industries Division: Penn State University.

"What Would You Have Found?"

A LANDOWNER once invited four young men to spend their summer holiday on his small, rocky farm. He promised to give them anything of value they might find on the place. They came and, after a careful survey, one grunted, "There's nothing here that I want. There's nothing to see, nowhere to go, nothing to use."

Another, who was an artist, admired the scenic beauty of the winding valley, and depicted its scenes on canvas.

Yet another, a botanist, found his delight in gathering certain rare herbs and roots, which brought him a tidy sum from a manufacturing druggist.

The fourth, a geologist, made certain explorations which brought him a few nuggets of gold. Every man found what he was trained to look for. Is this not a portrait of life?

George S. Reamey.

The One-Handed Can Be Lapidaries

By WM. J. BINGHAM

JUST because you have only one usable hand is no reason you cannot do first class lapidary work, or many other kinds of work, for that matter. A few gadgets and procedures are described below. These devices are some that I use myself, since I was paralyzed on my right side by a stroke two years ago. No dimensions are given as they can be made any size and from any material that is available. The work is not as easy as with two hands, but with a little practice and the desire to do something, it can be done. It is assumed that the handicapped person has, or has available to him, ordinary lapidary machinery; and that he knows how to use it, as this article is not intended to give instructions on cutting and polishing.

In operating a slab saw, most of the time a rock can be wedged in the vise long enough to tighten it up; or a temporary rest can be made for the stone to hold it until it can be tightened in the vise. The temporary rest can be a few small pieces of wood of various thicknesses. *SEE FIG. 7.* Trim sawing presents no problems.

For grinding, a rest for the stone, especially for slabs and cabochons, is very handy; even for two-handed lapidaries. The top of the rest should be about level with or a little below the center of the shaft. It should have a metal wearing surface on the top. It can be made from either metal or wood, preferably non-rusting. It should be heavy and substantial to prevent vibration. *SEE FIG. 8.*

In smoothing (sometimes mistakenly called sanding) specimens on a flat, horizontal disk, no problem is involved; but on a vertical disk or drum, a rest similar to the one described for grinding may be called for. For smoothing cabochons, the first operation is dopping. This may be different from the way you have been doing it, but it works nicely using only one hand. First, provide a source of heat; such as an alcohol lamp or a candle. Be sure to have the wick of the candle short enough to prevent smoking. Second, provide a suitable dop stick, the end of which is just a little smaller than the cabochon being worked on, and is lightly coated with dopping

Fig. 1 Hold down, over-all view, showing foot pedal.

Fig. 2 Jam peg, with dop stick and cabochon in place on smoothing lap.

Fig. 3 Squeezing hot wax out from under cabochon.

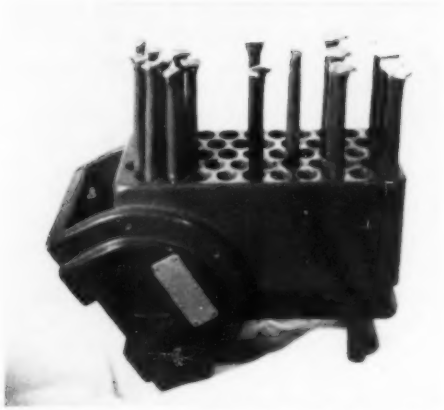


Fig. 4 Setting dop stick with cabochon aside to cool.

wax. Third, place the roughed-out cabochon bottom side up on the table or bench. Fourth, hold the dop stick, wax end down, about two or three inches above the flame, so that the wax is slightly softened; then touch the back of the cabochon with the waxed end of the dop stick, which will then pick up the cabochon. Hold the cabochon two or three inches above the flame, moving it around so that it will be evenly heated and keeping the dop stick approximately vertical. Keep heating it slowly, pressing it against the table or bench top occasionally; and when the wax squeezes out around the dop stick, turn the dop stick around so that the cabochon is on top, and set aside to cool. When cool it is ready to be worked on. *SEE FIGS. 3 and 4.*

Another thing that will help in smoothing cabochons on a flat, horizontal disk is a jam peg, a rest to hold the dop stick at the desired angle. This can be made from wood which is fastened to the table or bench top, and has a number of shallow holes on the side towards the lap plate. *SEE FIG. 2.* A third help is an adjustable arm which will hold a caliper or a template, to measure the cabochons as they are being shaped on the lap plate. *SEE FIG. 5.*

Polishing should present no new problems. To remove the cabochon from the dop stick, there are two

Fig. 5 Adjustable arm, with calipers in place, indispensable tool for good work.

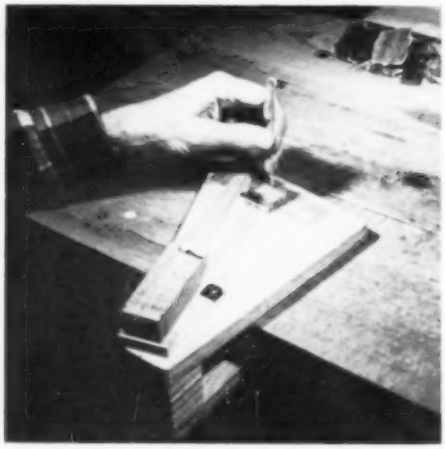


Fig. 6 Hold down, with template in position on slab, for marking.

methods; one is to heat the cabochon enough to soften the wax underneath but not melt it, when it can be removed without a lot of wax sticking to it. A little alcohol on a rag will remove the wax that is left on the cabochon. The other method is to put the cabochon and dop stick in the refrigerator or freezer for a half hour or so, at which time the cabochon will drop off.

Another gadget that is very handy for the one-handed is a foot-operated hold down. This is used for many operations around the shop besides lapidary work. It can be modified many different ways and used for many things and still keep the same idea of using foot pressure to hold something down, or perform some other operation. It consists of a base that can be clamped to a table top or bench top; a bar or board foot pedal which is attached by means of a cord to a pivoted arm, the pointed end of which is the hold down. *SEE FIG. 1 and 6.*

I hope that this article will help some handicapped person get a little more enjoyment out of life and probably make a few dollars while doing it. I will enjoy hearing from you.

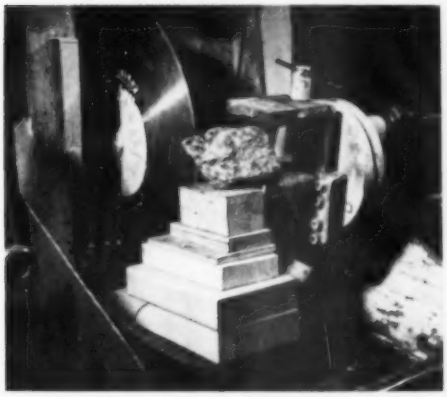


Fig. 7 Temporary rest for stone about to be clamped in saw.

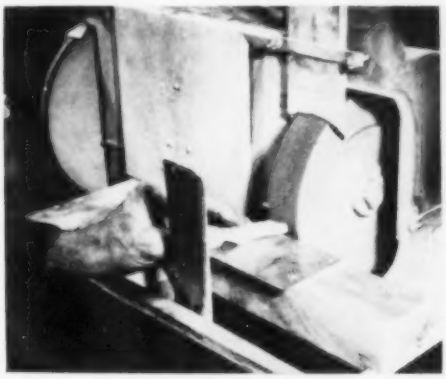


Fig. 8 Rest for grinding.

A WORTHWHILE PROJECT

THE Division of Recreation of the Chicago Park District is sponsoring classes in lapidary and jewelry crafts during the present winter season, under the efficient instruction of Ray C. Miller. Classes are now being regularly held as follows:

Lincoln Park, 2041 Lincoln Park West.
Tuesdays, Wednesdays and Thursdays.
3:00 to 5:30 and 7:00 to 10:00 P.M.

Jefferson Park, 4820 North Long Ave.
Mondays and Fridays.
3:00 to 5:30 and 7:00 to 10:00 P.M.

All who may be interested in such opportunity as is afforded by these classes should contact instructor Miller, at the time and places indicated.

ELEPHANT BONES ARE FOUND

SCARCELY a month passes but the discovery of mastodon or mammoth elephant bones is announced by someone from widely scattered areas.

This month we read that a large section of vertebra and part of a tooth was recently discovered by Mrs. George Jacobs and her daughter, "Joy," along the banks of Cedar Creek, southwest of Oakland Mills, in Henry County, Iowa.

Excavation for a new channel for the creek and erosion that has followed has resulted in the bringing of the bone and teeth to the surface. The deposit is in the age of the Kansan glacial drift (Pleistocene).

LAPIDARY PROCESSES: SMOOTHING

By WM. J. BINGHAM

SMOOTHING is a continuation of the grinding process in its basic aspects, but with provisions for better control and in which finer and finer abrasives are used to cause finer and finer scratches until they are so small that they polish out readily. A properly smoothed agate surface, for instance, can be perfectly polished at a rate of not more than 3 minutes per square inch, usually somewhat less.

For working curved surfaces, water proof, silicon carbide coated cloth is stretched across a flat metal plate by a clamping ring, or the cloth is cemented to three separate face plates which can be readily changed. This unit is mounted in a stand or table so that the face plate is just below the table surface and is surrounded by a collecting trough or ring to collect and drain away the water thrown off when revolving. The flat disc arrangement provides a zero speed at the center changing to a maximum at the rim so a suitable speed can be found for any operation. No backing or cushion is used. The first smoothing should be done with #220 grit cloth followed by #400 and finished with #600. The rough grinding scratches should be placed in one general direction on the specimen and if the #220 scratches are placed at an angle to these, then the coarse ones will be plainly visible as long as they are present and when they disappear, the #220 step is finished! The same indication is used on the #400 and #600 steps.

Water from an overhead tank is piped to a nozzle just over the center of the face plate and a valve in the line is adjusted so that the nozzle drips water at the rate of 2 or 3 drops per second on the center. It then flows radially across the cloth and washes away the cuttings and cools the stone.

There are many other arrangements used for smoothing, such as horizontal shafts with face plates, sanding drums, belt sanders, and lap wheels with loose abrasives, but they do not have the advantages of the vertical shaft face plate set in a table in the way of convenience, cleanliness, control, and versatility. If a jam peg is set up along side the face plate, faceting and flat sides cabachons can be made easily as well as the placing of accurate bevels on the edges of cabachons.

The method of smoothing a curved surface of a specimen by this method is very simple: the specimen is grasped firmly in the fingers or in the hand with the roughly ground surface down in contact with the revolving abrasive surface. The stone is swung in an arc by *rotating* the fore arm first one way and then to the opposite side through an arc of about 60 degrees (depending on shape of stone) at a rate of 4 or 5 swings per second and at the same time slowly moving the stone at right angles to this swinging by bending the hand up and down at the wrist at a rate of once every 4 or 5 seconds. This will cause the contact point between the stone and abrasive surface to travel in a zig-zag path that will cover the area being worked on. It is best to work on a small area (approximately the size of a quarter) at a time and complete the step on that area before moving over to the adjacent area.

Finally—never perform any smoothing operations *dry* as a stone dust is very detrimental to your health and also makes it difficult to control the heat developed in the specimen.

(Ed. Note) William J. Bingham, professional lapidary, a member of the Editoral Staff of EARTH SCIENCE, is well known as an authority on Lapidary Processes.

DECATUR ROCKRAMA A FINE SUCCESS

CENTRAL ILLINOIS ROCKHOUNDS were hosts to the Midwest Federation's second Rockrama on Sept. 23-24-25 and scored an outstanding success. The displays were beautifully laid out and contained a well balanced variety. Maurice Lamb showed his wonderful collection of geodes; Kenneth Evans displayed his beautiful shell cameos (they are his own work); Merton Young featured plant fossils from the new area near Terre Haute, Indiana (they are similar to those found at Braidwood, Illinois); LaFayette Funk displayed a priceless collection of Chinese soapstone carvings; and the new Midwest Federation case made its debut filled with flowers created from slabs of agates, and other gem materials by the Des Moines Lapidary Society. In addition there were many other excellent displays of gems, minerals and fossils. The Rockrama also featured many interesting and informative lectures.

Many Midwest affiliates were present from several states, and the first Directors meeting of the 1960-61 club year was held on Saturday afternoon and evening, presided over by our new president, Floyd H. Mortenson, of Pontiac, Michigan. Various reports were heard, and other routine business matters were transacted. A full quota of Rockramas, three in number will be held next year, one in each of the sub-regional areas not having the annual convention.

Bernice Rexin.

FLUORESCENCE

By PAUL F. ELARDE

ALMOST every rock-hound, already fascinated with the variety of crystal forms, textures, color, etc., which characterizes his collection of minerals, is doubly fascinated when he sees some of them glowing in brilliant new colors under the influence of ultraviolet light. It is only natural that a separate "special" collection of such minerals is eventually added to his display. Appropriately enough, the term "fluorescence" applied to this phenomenon, the emission of a new set of radiations from a substance exposed to radiations of a different wave length, or color, is derived from Fluorite, a mineral that usually fluoresces a deep blue.

Fluorescence is actually a special case of luminescence, which in itself refers to the production of visible radiation by means other than heating to incandescence. A prefix is often added to indicate the type of activation which is producing the luminescence. We thus have the terms bio-luminescence, referring to light produced by biological reactions such as occur in the firefly, glowworm, certain bacteria, etc. Triboluminescence, whereby light is produced by the mechanical disruption of crystals; chemiluminescence, applying to chemical reactions which produce light without much heat, etc.; and, of course, photoluminescence, which is also called fluorescence. In the case of fluorescence, the term has been extended to include the emission of any radiation, visible or invisible, by means of other radiation. For example, the presence of many elements in metal alloys can be determined by means of the characteristic x-rays they emit when activated by other x-rays, and the method is called X-Ray Fluorescence Analysis.

Fluorescent materials usually absorb light of higher frequency (shorter wave length) and emit light of lower frequencies (longer wave length). The best known fluorescent materials, of course, are those which emit light in the visible region. In vated by ultraviolet light, which is general, these materials must be actipopularly called black light because it is invisible to the human eye.

Fluorescent materials emit light only while exposed to the activating radiation, and cease emitting immediately with the removal of the radiation. If the fluorescence persists for a measurable length of time after exposure to excitation, the material is said to be phosphorescent. The time of persistence ranges 10^{-8} seconds in some materials to 20 hours or more in other. Actually, no sharp line can be drawn between fluorescence and phosphorescence.

Many gases, liquids, and solids are known to fluoresce, and the fundamental mechanism involved in each case is associated with atomic, molecular, and/or crystal structure. In solids, such as the minerals, fluorescence is ordinarily due to the presence of certain impurity atoms called activators, although in some cases, an excess of one of the normal crystal atoms is responsible. The type of activating atoms i.e., copper, manganese, silver, etc., present in the crystal determines the fluorescent colors which will be emitted. The theories developed on the subject are rather complex, and as yet do not explain all the facts observed. For readers interested in the more technical aspects of the subject, it is suggested that books on solid state physics be consulted.

For the rock-hound, of course, the most interesting fluorescent materials are the naturally occurring minerals, most of which respond best to the short-wave ultraviolet region (2537 Angstroms), though some respond best to the long-wave region Angstroms. Among the most spectacular minerals are fluorite (Cumberland, England, deep blue—3650); willemite (Franklin County, New Jersey, bright green, —3650, 2537); calcite (Franklin County, New Jersey, flame red, —2537); scheelite (Tucson, Arizona, bright blue, 2537); autunite (Hazardville, Connecticut, green, 2357); calcite (Terlingua, Texas, red—3650;

blue, 2537 with strong initial phosphorescence). Note that the last mentioned calcite shows three effects.

The fluorescent properties of minerals have led to the extensive use of portable ultraviolet lamps for prospecting purposes, and many valuable finds have been made. Radioactive minerals that do not fluoresce can often be detected by means of the fluorescent effects produced when the emitted particles strike a fluorescent screen. In this case, a small piece of the suspected radioactive mineral is placed near the screen and examination of the screen is made in a darkened room with a magnifying glass of about 10 power. Particles emitted from a radioactive mineral will produce momentary pinpoint or "sparks" of light where they strike the screen. The device is known as a spinthariscope (from the Greek Spinthor meaning spark) and the flashes of light are called scintillations. When a photomultiplier cell and associated equipment are used to detect the "sparks" we have an instrument called a scintillation counter. These instruments are somewhat more sensitive than the Geiger counters, which work on a different principle. Another prospecting method which uses a fluorescent effect is that for Mercury ores. Here a fluorescent screen is exposed to ultraviolet light having a wave length of 2537 A° (one of the principal lines of mercury). The suspected mercury ore is then placed between the lamp and the screen, and gently heated. Any mercury vapor rising from the specimen, though invisible to the eye, will cast a dense smoke-like shadow on the screen. This test is very sensitive to mercury, but the reader is cautioned that mercury vapor is poisonous, and proper precautions against inhaling the vapors should be taken.

The early detected fluorescence of fluorescein solutions, even when very dilute, is utilized in tracing water seepage through the ground, for example from sewers, wells, etc. A particularly interesting example of the use of this material was made around 1878. A quantity of concentrated solution was poured into the bed of the upper Danube River, which, in summer, completely disappears into the porous rocks of the Jura mountains. Some fifty hours later, the typical green fluorescence was observed in the River Aache, which rises in the same mountains, but many miles to the south, and flows into Lake Constance in Switzerland. This proved the existence of a subterranean connection between the Rhine and the Danube.

"ABOMINABLE GLACIERS": Pleistocene glaciers, once called the "Abominable Glaciers" by a distinguished earth scientist, were really of great benefit to mankind. While they may have been temporarily detrimental and destructive to most forms of life existing in their path, there can be no doubt that they were of great value in many ways to later generations. Of these benefits we need list only a few.

Being perhaps both the greatest grinding or milling force, as well as the greatest transporting agency of nature, they filled and obliterated most of the old preglacial erosional valleys, leveling off and smoothing the entire surface of the land, thereby forming the great arable areas (plow-lands) now existing in our central states. They also renewed and enriched our mineral depleted soils by grinding and bringing down from the far north those necessary mineral elements from the granitic rocks of the Laurentian Shield, and, last but not least, by their transporting ability they brought down for the rockhounds a great abundance of many mineral specimens which we may now find in our own back yards, so-to-speak, that otherwise we would have to travel many hundreds of miles from home to find.

As to the direct or indirect causes attempting to account for the geologic occurrence of Continental Glaciation there are many, at least thirteen which might be listed, both terrestrial and extraterrestrial, all of which have some merit. So far, not any of them have proved entirely satisfactory, and until now the entire matter yet remains one of the great geologic mysteries, and let us not forget that great periods of continental glaciation have previously occurred in many parts of the world in far distant geologic time, even in equatorial regions, as in Africa in Devonian time.

The Minerals of the Chicago Area

By TOMASZ J. TURLEY

THE first index and adequate description of the minerals of the Chicago Area was published in 1902 by Dr. Alja Robinson Crook. It includes names of fifty minerals, only about twenty of which are indigenous, or belong to the bedrock of the region. The remainder are found in the glacial drift and are spoken of as emigrant minerals. The valleys of the Chicago and the DesPlaines rivers, the lake shore, clay pits, stone quarries, and gravel banks are all very favorable areas for the collecting of these so-called emigrant minerals.

During the intervening period, since the publication of Dr. Crook's "Minerals of the Chicago Area," there have appeared relatively numerous publications covering the geology, geography and petrology of the Chicago region, especially concerning the physical and chemical properties of minerals as they might apply to the industrial resources of greater Chicago.

The study of the geological literature concerning the Chicago region and personal observation in the field by the author has permitted the compilation of a list of the minerals of the Chicago region which are described in the literature studied. This list now includes some 72 minerals of which only 24 are indigenous to the bed rock and the rest are minerals described and known in rocks of quaternary deposits (drift and other recent deposits), known as the "mineral emigrants". The number of the mineral emigrants could theoretically be extended much farther.

The author has also prepared a bibliographical list of these publications arranged chronologically in the subjects of geology, mineralogy, and geography of the Chicago area, 86 titles in all.* It has been his intention to include all articles and books bearing upon the subject matter, but some may have escaped his attention, and he will therefore appreciate any supplements or corrections which may be received from his readers.

(Author's address: 2101 N. Kedzie Avenue, Chicago 47, Illinois)

See next page

Outcropping of dolomitic limestone containing asphaltum inclusions. Photo taken near Stony Island and 93rd Street, Chicago.

Glacial deposits typical of the DesPlaines valley. A prolific source of "Immigrant Minerals." Photo taken near Sag Bridge.

A Preliminary Alphabetical List Of Minerals of the Chicago Area

After A. R. Crook with supplements by T. J. Turley

ACTINOLITE. Occurs in beach sands as accessory mineral.
AGATE. Occurs as rare mineral in dolomitic limestone chert nodules.
AMPHIBOLE (see ACTINOLITE).
APATITE. Found in drift igneous rocks and accessory mineral in beach sands.
ARAGONITE. Found in geodes, and in stalactites.
ARGENTITE. Very rarely found in connection with galena in dolomitic limestone.
ASPHALT. Occurs in dolomitic limestone, Stony Island and 93rd Street.
AUGITE. Occurs in igneous drift rocks, in the lake shore sands.
AZURITE. Occurs with malachite, as an incrustation.
BIOTITE. Occurs in igenous drift rocks, in beach sands.
CALCITE. Occurs as chief mineral in limestone, dolomitic limestone, in geodes. Fine scalenohedron calcite crystals have been found at Stony Island and elsewhere.
CHALCOPYRITE. Found in dolomitic limestone, Sag Bridge.
CHALCEDONY. Occurs in limestone, dolomitic limestone, in beach sands.
CHALCOCITE. Found in dolomitic limestone, associated with chalcopyrite.
CHERT. Occurs in dolomitic limestone, in beach sands.
CHERT, CALCAREOUS. Occurs in dolomitic limestone.
CHLORITE. Found in beach sand, as accessory mineral.
COPPER. Found in the drift throughout the area.
CORUNDUM. Found in the lake shore sands as accessory mineral.
CUPRITE. Found in the glacial drift.
DIAMOND. Found in the drift north of Chicago at Burlington, Wisconsin.
DIOPSIDE. Occurs in sands as accessory mineral.
DOLOMITE. Occurs as chief mineral in limestone, dolomitic limestone, in geodes. Fine dolomite crystals have been found at Sag Bridge.
EPIDOTE. Found in sands as accessory mineral.
FLUORITE. Found in igneous drift rocks, also in dolomitic limestone.
GALENA. Occurs in the cavities of the limestone, in the drift.
GARNET. Occurs in the lake shore sands, in the drift boulders, etc.

(Continued from preceding page)

GLAUCONITE. Found in dolomitic limestone, Sag Bridge.
GOLD. Found as very rare mineral in the drift, in the lake shore sands.
GRAPHITE. Occurs in the drift (metamorphic rocks).
GYPSUM. Found in the clay beds.
HALLOYSITE. Found in the clay.
HEMATITE. Occurs in balls in the clay, in the drift.
HORNBLENDE. Occurs in the drift rocks.
HYPERSTHENE. Found in the igneous drift rocks, in lake shore beach sands.
ILLITE. Found in insoluble residue of limestone, in clay.
ILMENITE. Occurs in beach sand, in the drift.
JASPER. Found very commonly in the drift.
KAOLINITE. Found in insoluble residue of limestone, in clay.
KYANITE. Occurs in sands, as accessory mineral.
LABRADORITE. Occurs in igneous drift rocks.
LEUCOXEN. Found in sands as accessory mineral.
LIMONITE. Occurs in dolomitic limestone, clays, beach sands.
MAGNETITE. Occurs in the beach sands, of the lake shore. About 2% has been found in Evanston, the University Campus, in igneous drift rocks.
MALACHITE. Found on the native copper in the drift.
MARCASITE. Occurs widespread in dolomitic limestone.
MELANTERITE. Found in small amounts in dolomitic limestone, in the peat.
MICA (See BIOTITE and MUSCOVITE).
MICROCLINE. Occurs in igneous drift rocks, in beach sands.
MILLERITE. Found as very rare mineral, in dolomitic limestone, associated with sphalerite.
MONAZITE. Found as rare mineral in beach sands.
MONTMORILLONITE. Variety of clay mineral, found in clays.
MUSCOVITE. Occurs in igneous drift rocks, in beach sands.
NATURAL GAS. Occurs in small quantity in artesian well, peat beds, etc.
OLIGOCLASE. Occurs in igneous drift rocks, in sands.
OPAL. Occurs in dolomitic limestone, in small cavities.
ORTHOCLASE. Occurs in igneous rocks of drift, in beach sands.
PEAT. An impure lignite, occurs under gravel, above the clay.
PETROLEUM. Found in pockets or vugs in Niagaran limestone.
PLAGIOCLASE. (See LABRADORITE, OLIGOCLASE).
PYRITE. Occurs in dolomitic limestone, widespread.
PYROXENE (See AUGITE, HYPERSTHENE).
QUARTZ. Occurs in igneous drift rocks as pebbles, and in sedimentary rocks.
ROSE QUARTZ. Found in beach sands.
RUTILE. Found in beach sands, in boulders from glacial drift, as inclusions in quartz.
SILLIMANITE. Occurs in beach sands.
SILVER. Found in the copper specimens in the drift.
SIDERITE. Occurs as incrustations on dolomitic limestone.
SPHALERITE. Found in the dolomitic limestone.
STAUROLITE. Occurs in beach sands as accessory mineral.
SULPHUR. Found as a secondary product of marcasite.
TITANITE. Occurs in beach sands, in igneous drift rocks.
TOPAZ. Found in beach sands, rare.
TOURMALINE. Found in drift rocks, in beach sands, very rare.
WATER. Easily found everywhere in the region. (Yes, water is a mineral.)
ZIRCON. Found in igneous drift rocks, in beach sands as accessory.

The chronological bibliography of articles covering the geology, mineralogy and geography of the Chicago area, prepared by the author listing nearly 100 references has been mimeographed and may be had upon request by writing the author, enclosing a self addressed large return envelope franked with 4c postage.

Geology of the Grandfather Mountain

By JASPER L. STUCKEY*

The Split Rock on the road to the top of Grandfather Mountain is one of the geologic wonders of the mountain area.

THE rocks of the earth's crust are divided into four great groups formed during long periods of time commonly called eras. These eras from oldest to youngest are Precambrian, Paleozoic, Mesozoic and Cenozoic. The Precambrian era began about a thousand million years ago and lasted approximately 500 million years. The Paleozoic era began about 550 million years ago and lasted approximately 300 million years. The Mesozoic era began about 200 million years ago and lasted approximately 140 million years. The Cenozoic era began about 60 million years ago and continues to the present time.

Throughout much of Precambrian time, sedimentary formations consisting of sandstones and shales of varying compositions were laid down, granites and related rocks were intruded and lava flows were formed. Following metamorphism of these older rocks, a formation consisting of sandstones, quartzites, shales, slates and much conglomerate was laid down on what is now Grandfather Mountain.

At the beginning of the Paleozoic era, a great trough was formed along the line of the present Appalachian Mountains. During that era, sediments accumulated in that trough and were raised and folded into the Appalachian Mountains at the end of that era, or approximately 200 million years ago. During the Mesozoic era which lasted approximately 140 million years, these mountains were worn down to almost a level plain. During the Mesozoic era most of the formations younger than Precambrian were eroded and carried away from the Grandfather Mountain area. At the beginning of the Cenozoic era, approximately 60 million years ago, the

region of the Appalachian Mountains was raised approximately four thousand feet without further folding. During the past 60 million years of the Cenozoic era the present Appalachian Mountains have been carved by weathering and erosion out of these elevated rocks.

The formation covering Grandfather Mountain today was laid down as sediments in Precambrian time, probably more than 550 million years ago. The best defined part of this formation is a conglomerate composed of pebbles of quartz, granite, slate, rhyolite and other rocks. Many of the pebbles are more than a foot in diameter and most of them are angular and sharp, showing no great amount of transportation. These pebbles were derived from formations much older than the one in which they now occur. As a result, the conglomerate beds on Grandfather Mountain are composed of pebbles that are estimated to be as much as 800 million years old, and probably come from some of the oldest rock formations in the world.

ROCKS AND MINERALS OF THE AREA

Visitors to Grandfather Mountain find themselves in an area of complex and interesting geology and within a few minutes drive of some of the most important mineral localities of the Southeastern United States. The rocks and minerals of the area are so important that the State of North Carolina constructed and the National Park Service maintains, at Gillespie Gap on the Blue Ridge Parkway, a Museum of North Carolina Minerals, where many of them are on display.

With relatively simple equipment, the person who prefers to make his own collection rather than viewing specimens in a museum, can in a few days time make a collection that he will be proud to possess and display. The materials to be collected are so diverse that a person may make his collection as simple or variable as time and interest permits. Beautiful cabinet specimens of rocks and rock forming minerals may be obtained from the different geological formations of the area, while many of the pits, mines and mine dumps furnish not only beautiful cabinet specimens, but also specimens of mineral matrix, individual crystals and crystal fragments of semiprecious and precious gem stones suitable for cutting, polishing and faceting.

The best places to look for mineral specimens are in active mines, old pits, mines and mine dumps. Any good exposure of rock should be examined, while railroad and highway cuts, gullies, stream banks and stream beds often furnish good specimens. Freshly plowed fields have furnished excellent specimens of minerals that are resistant to weathering.

From the conglomerate found on and around Grandfather Mountain, good specimens of granite, slate, metarhyolite (schistose, massive and porphyritic), black schist, quartz, epidote, feldspar and jasper, as well as, sandstone and arkose may be collected. From the rock formations exposed within a few miles of Grandfather Mountain, specimens of granite, gneiss, quartzite, slate, diabase, gabbro and greenstone may be collected at a number of localities convenient to roads.

At the north foot of Beech Mountain on the waters of Buckeye Creek, which flows east into Beech Creek, galena, a lead mineral, has been found at a few localities. The galena is associated with pyrite in small quartz veins which occur in a greenish schist. On the north side of Grandfather Mountain, about a mile southeast of Watauga River, gold occurs in quartz veins associated with pyrite. The principal vein, about 8 feet thick, and several smaller ones occur in a black slate.

Within a radius of 3 miles of Elk Knob, Watauga County, and at Ore Knob, Ashe County, good specimens of copper minerals may be collected. The chief copper minerals at both localities are chalcopyrite, azurite and malachite, associated with pyrite. At the Ore Knob mine, in addition to the

above mentioned minerals, cuprite, native copper, arsenopyrite and pyrrhotite are present. The Ore Knob mine is being worked for the copper mineral, chalcopyrite.

At the Duncan mine, 1.2 miles southwest of West Jefferson, Ashe County, both mica and beryl may be found. The beryl is not of gem quality, but good cabinet specimens may be found. Well formed crystals of staurolite occur in a muscovite-biotite gneiss along the north side of the North Fork of New River, approximately 0.5 mile east of Crumpler, Ashe County.

In Alleghany County, 4 miles north of Sparta on Crouse Knob, which lies south of Bald Knob, is an interesting manganese deposit on which several pits have been opened. On the dumps from these pits, specimens of alleghanyite, tephroite and galaxite may be found. Barite veins occur north of highway N.C. 93, 2.3 miles northwest of Amelia. At the Maxwell or Peach Bottom copper mine west of Strafford in the area between Strafford and Elk Creek, the minerals pyrite, chalcopyrite, galena, sphalerite, malachite, cuprite, and molybdenite occur.

At the Cranberry mine near the village of Cranberry, Avery County, good specimens of magnetite, hornblende, epidote, feldspar and garnet may be found. Some of the epidote makes good en cabochon cuts.

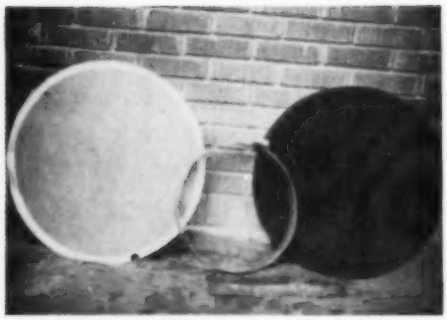
In Burke, McDowell and Caldwell counties, to the south of Grandfather Mountain, a number of localities containing minerals such as corundum itacolumite (flexible sandstone), garnet, gold, monazite, amethyst and tourmaline are to be found, while in Alexander County, to the east of Caldwell County, a wide variety of minerals including hiddenite, emerald, beryl, rutilated quartz, smoky quartz, rose quartz, rutile, xenotime, monazite and graphite occur.

About 30 minutes drive along the Blue Ridge Parkway, southwest of Grandfather Mountain and six miles off the Parkway, is Spruce Pine, the gateway to the Spruce Pine Pegmatite District, which is one of the most important mineral collecting districts in the southeast. In this district, which includes parts of Mitchell, Avery and Yancey Counties, are numerous mines and pits, some of which are being worked and some of which are abandoned. From the dumps and walls of these mines and pits a wide variety of minerals, many of which can be cut and polished may be obtained for the collecting. The list of minerals to be collected in this district is too long to give here. The following indicates the wide variety present: Feldspars of several species and colors, mica, quartz, hyalite, garnet, apatite, epidote, thulite, emerald in matrix, corundum, tourmaline, uranium minerals, beryl, aquamarine, allanite, vermiculite, talc, soapstone and actinolite.

Still farther southwest in Buncombe, Madison, Haywood, Jackson, Macon, Clay and Cherokee Counties, the minerals garnet, corundum, ruby, kyanite, olivine, bronzite, anthophyllite, epidote, garnerite, genthite, tremolite, actinolite, tourmaline, beryl, quartz of various colors, staurolite, sillimanite, spinel, smaragdite, talc, rutile and ottrelite, occur at many localities.

Those desiring to spend several days collecting in the areas mentioned above should secure from Department of Conservation and Development, Raleigh, North Carolina, a copy of Information Circular No. 16, "Mineral Localities of North Carolina," price fifty cents per copy. This report was prepared especially for collectors and contains a list of the more important minerals to be collected, the localities where they may be collected, and specific directions for reaching these localities.

*Dr. Jasper L. Stuckey, a nationally known geologist, has served North Carolina in many capacities during the past forty years. He is an authority on the State's geology and mineral resources.



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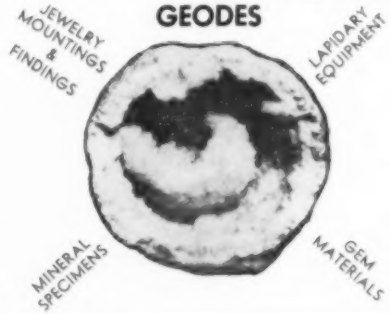

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Midwest Club News

Mrs. Bernice Rexin, Club Editor
3934 N. Sherman Blvd.
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INDIANA GEOLOGY AND GEM SOCIETY'S founder, Francis M. Hueber, recently discovered a fossil liverwort in the Catskill Mountains that was found to date back 333,000,000 years to the Age of Fishes. Since the plant must have been evolving for millions of years before it reached the development shown in the fossil and may have existed as early as the Cambrian age, Dr. Hueber's discovery has upset paleobotanists' theories of how long land plants have existed on earth. Dr. Hueber reports that his lapidary experience comes in handy when he is slicing sections of plant fossils for microscopic study.

MINNESOTA MINERAL CLUB on September 11 visited a newly discovered area near River Falls, Wisconsin for fossils and agates. On a slope at the side of the road, some nice trilobites and a variety of other marine fossils were found. Across the road many good Lake Superior agates were collected.

CHICAGO ROCKS AND MINERALS SOCIETY on October 8, enjoyed a demonstration-talk on sand and centrifugal castings, and jewelry hand tools and their uses, which was given by Sam Bartlett, retail seller of jewelry tools, supplies and findings. Mr. Bartlett brought a fascinating array of tools to the meeting to acquaint the society with the many kinds of tools that are available and their specific uses.

TRI-COUNTY ROCKS AND MINERALS SOCIETY was recently given an interesting talk on "Limestone Fossils," and a demonstration on casting them, by Donald North who has studied these fossils for forty years. Mr. North also showed the group how to repair a limestone fossil so that the resulting joint is invisible.

MESABI ROCK AND MINERAL CLUB on October 20, in Buhl, Minn. was shown a slide program, "The Quartz Family Minerals." This same fine program was given to the Itasca Rocks and Minerals Club in Grand Rapids, Minn. on October 26. The two clubs plan a joint trade session and silent auction in Hibbing, Minn. during November.

NEBRASKA MINERAL AND GEM CLUB held a successful picnic and auction on August 28. Rain cut short the field trip which the society had planned to follow the picnic.

MEMPHIS ARCHAEOLOGICAL AND GEOLOGICAL SOCIETY on October 15 was host to the annual meeting of the Tennessee Archaeological Society, which was held in the Chucalissa (house abandoned) Museum in Memphis. Four of the ten interesting and educational papers presented at the meetings were given by members of MAAGS.

EVANSVILLE LAPIDARY SOCIETY opened its fall session with an interesting talk on "Jewelry Work Among the Indians," by James Worley, a graduate of U.C.L.A. where he majored in mechanical engineering. Mr. Worley is a member of the Iroquois nation.

MICHIGAN LAPIDARY SOCIETY'S carving artist, Betty Riberdy, is teaching members of the society how to carve figures from stone. The class is presently carving small figures from alabaster.

SHAWNEE-MISSION GEM & MINERAL SOCIETY recently visited the geode area in Illinois and collected an abundance of geodes which contained a variety of minerals. One of the most beautiful geodes collected in this area is one containing double terminated quartz crystals and it has been named the Dew Drop Geode by its discoverer, Maurice Lamb. The heart of this famous geode area is Hamilton, city in Hancock county, and will be the site of an Illinois State Geological Survey field trip on May 6, 1961. Anyone interested in collecting geodes is invited to participate in this trip. Its assembly point is Hamilton High School at nine A.M.

WABASH VALLEY GEM AND MINERAL SOCIETY recently visited the Vermont Marble Company near Remington, Indiana, where it was shown the various steps used in cutting and polishing marble for commercial uses. The plant stocks over 100 varieties of marble, including the Danby, Vermont marble used for the Jefferson Memorial in Washington, D.C. and the Rutland marble used to build the Supreme Court Building.

FLINT ROCK AND GEM SOCIETY has been offered an opportunity, by the Mott Foundation, to attend classes this fall in lapidary, rocks and minerals identification and geology. The level of the classes ranges from children's courses to those giving college credit.

MICHIGAN GEM AND MINERAL SOCIETY held its annual exhibit at the Jackson Fair during August. The club's display of fossils, lapidary work, minerals and fluorescent materials is so popular with the general public that the Fair Board is considering giving the society a permanent display area with built-in cases.

MARQUETTE GEOLOGISTS SOCIETY heard Kenneth Russell, at its October meeting, give an illustrated talk on his recent Western trip, and viewed slides of Mrs. Armella Meyers' summer visit to Niagara Falls. The members held a lively swap session after the talks and slides.

CENTRAL MICHIGAN LAPIDARY AND MINERAL SOCIETY is planning to repeat its very successful series of workshop classes which it held last spring. The classes included:

1. Care and use of the Diamond Saw and Grinding Wheels
2. Demonstration of Cutting and Polishing a Slab
3. Demonstration of the Slab Saw and Sphere Machine
4. Demonstration of Cutting and Hand-Polishing Cabochons
5. Tumble Polishing Techniques and Wire Mounting of Stones
6. Scroll Sawing and Design of Brooches from Abalone Shell
7. Making Jewelry from Tumble-polished Baroques

MUSKEGON COUNTY ROCK AND MINERAL ASSOCIATION recently held an auction of choice minerals, fossils, and gem materials supplied by the Lakeside Gem and Mineral Club of Kennewick, Washington. In exchange for the fine selection of West Coast materials, MCRMS shipped a large box of Michigan specimens to LGMC. Both clubs carefully identified their materials as to name and locality.

GRAND RAPIDS MINERAL SOCIETY'S guest speaker at its September meeting was Rev. Luke McMillian, who showed the group his latest film "Rockhounds' Paradise," which covers the highlights of a 10,000 mile trip made by Father McMillian. It includes scenes of Niagara Falls, Garden of the Gods, Grand Canyon, Carlsbad Caverns and minerals found in these areas.

CHICAGO LAPIDARY SOCIETY, at its September meeting, presented plaques to all of its past presidents and celebrated the tenth birthday of its official publication, *The Template*.

ST. LOUIS GEM AND MINERAL SOCIETY made a two-day field trip to Cave-In-Rock, Illinois on October 15-16. Each member of the party was allowed to collect three pounds of nice material from the mine in addition to the good massive fluorite specimens that he found on the mine dumps.

DES PLAINES VALLEY GEOLOGICAL SOCIETY made a late summer field trip to the gravel pit at Bellevue, where it collected Lake Superior agates in the rain. Wet agates glisten and are easy to spot in the gravel.

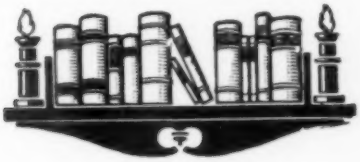
CENTRAL IOWA MINERAL SOCIETY viewed a 20-minute, colored film on "Modern Gem Cutting" on October 7, and then enjoyed a panel discussion on the various phases of lapidary work, by Harry Rinard, Curtis Thompson and Wayne Jones.

WISCONSIN GEOLOGICAL SOCIETY'S new field trip chairman, Paul Fuller, has kept the society busy and happy this fall with a variety of trips, including the following: 1. Halquist Quarry near Milwaukee on Aug. 7 to collect marine fossils. 2. Burlington and Muscatine, Iowa on Sept. 3-4 to collect geodes and agates. 3. Burlington, Wisconsin on Sept. 10 to attend the annual selling and trading meeting of the U.S. Indian Relic Collectors. 4. And Wausau, Wis. on Sept. 23-24 to collect quartz crystals and Wisconsin moonstone, and to attend the very excellent gem and mineral show put on by the Rib Mountain Gem & Mineral Society.

RECOMMENDED READINGS

"Art of Display," by June Culp Zeitner. September issue of *Glacial Drifter* (Topeka, Kan.) Mrs. Zeitner introduces her subject by pointing out that persons who are not born with a flair for display, can still master the art of display if they learn its basic principles. She sets forth these basic principles in a clear and readable fashion.

Book Reviews



MINERALS OF NEW MEXICO. Stuart N. Northrop, Professor of Geology, University of New Mexico. University of New Mexico Press. 655 pp. 1959. $10.

New Mexico has risen from 29th place in 1925 to 12th place in recent years in value of mineral production among the states. Copper is the most valuable single metal, followed by uranium, zinc, and a host of others.

This revised edition of Professor Northrop's book, first published in 1944, tells about all there is to know concerning New Mexico's minerals. Over 400 species and 130 varieties are cited. The first 100 pages are given over to data on the prehistoric utilization of minerals in New Mexico, utilization under the Spaniards, under the American occupation, and finally under statehood, all listed chronologically. There is a separate chronology of mineral discoveries in the states, also a summary of unpublished records of occurrence. Fluorescent and radioactive minerals are grouped in separate lists. In the last 500 pages the 400 plus minerals of the state are listed alphabetically. Popular as well as scientific names are included. For each are given chemical formula, crystal structure, cleavage pattern, and general characteristics such as color, hardness, etc. The counties of origin, with specific locations therein, are also included. A list of mining districts follows the main section, and over 60 pages of bibliography end the book.

The author is to be commended for his thoroughness. His work might well serve as a model for other compilations designed to focus attention on the mineral resources of a single state.

BEACHES AND COASTS. Cuchlaine A. M. King, Lecturer in Geography, University of Nottingham, England. St. Martin's Press, Inc. 403 pp. 1959. $14.50.

No one in the British Isles lives far from the sea so it is fitting that an analysis of the physical characteristics of beaches and coasts should originate there. For purposes of orientation, a coast is the area in which land and water meet, and a beach is the accumulation of more or less loose material on the shore line resulting from the action of wind, waves, and tides. Beach material is the natural protector of the coast line.

That coast lines have changed over the centuries is evidenced by maps of areas which have been surveyed with some degree of regularity. The author cites the south coast of England which has been surveyed at least 16 times since the end of the 16th century. Other evidence is obtained from analysis of shore bottoms. The coast of Lincolnshire, for example, has been steadily eroded since the 14th century. At periods of extreme low tide the stumps of trees which grew on the boulder-clay forming the shore in immediate post-glacial times are exposed. During the last 4 centuries the sea has advanced over the land between one-quarter and one-half mile. In the Dungeness area, on the contrary, it is the land which has encroached on the sea. Henry VIII tried to keep up by building Camber Castle as a coast defense when the town of Winchelsea became useless because of its increasing distance from the sea, but in a single century the coast land was to build out over 2000 ft. and leave even the fortified castle inland.

Beaches erode and accrue as a result of man-made as well as natural causes. Jetties built at Port Hueneme in California to control the natural drift of beach material caused accretion on the up-wave side and serious erosion on the down-wave side. In artificially replacing eroded material, care must be taken to supply fill of essentially the same character as the eroded material.

For engineers the chapter on waves is probably the most valuable in the book. Their generation (transfer of energy from the wind to the sea) is not yet fully understood, although the author gives us the benefit of many theories which have been advanced. The use of model tanks in research is discussed.

Each chapter is followed by a list of references, and the subdivisions of the chapters are briefly summarized. The imperfect state of our knowledge has perforce made organization of the material somewhat loose. The author is perhaps a little too anxious to credit previous workers in the field. The book should prove a stimulant to further research.

CRYSTAL-STRUCTURE ANALYSIS. Martin J. Buerger, Professor of Mineralogy and Crystallography, Massachusetts Institute of Technology. John Wiley & Sons, Inc. 1960. 668 pp. $18.50.

After a group of German scientists, in residence at Munich in 1912, learned through experimentation that x-rays were diffracted by crystals of copper sulphate and could demonstrate that crystals were triperiodic arrangements of matter with the periods on a molecular scale, it became possible to study the molecular dimensions of a crystal by observing the way it scattered x-rays. Since the electron is the scattering unit, crystallography, as a science, has contributed to and grown in importance with research in atomic energy.

The present book, following an earlier volume by the author "X-Ray Crystallography" (Wiley 1942), deals particularly with methods and equipment for analyzing crystal structures. As stated by the author, the analysis "consists in finding a structure whose diffraction spectra match the observed set." Absolute magnitudes can be determined from diffraction experiments, and the analysis comprises finding a structure model which would duplicate them.

Dr. Buerger reviews the available methods for making an analysis, discusses the proper procedures for selecting and preparing material, gathering data, etc. Each of the 23 chapters ends with an extensive list of references. Some familiarity with mathematics and statistics is desirable for readers of this book.

JADE IN CALIFORNIA. 24 pp. 50¢. DIVING AND DIGGING FOR GOLD. 24 pp. 75¢. Pages of History, P.O. Box 6, Sausalito, Calif. 1960.

If, as the Chinese say, a picture is worth 10,000 words, these little books tell much more than the number of their pages indicate. JADE is charmingly illustrated with original drawings by "SAJ." We particularly liked Wong Chan's skeleton, impeccably clothed in Chinese style, dancing along the path to his mine. For GOLD the publishers reproduced a Currier and Ives sketch, a Frederic Remington painting, and wood-cuts from 16th century Agricola's De Re Metallica. There are also excellent original drawings by Elinor H. Rhodes.

Both texts are entertaining combination of history, legend, and practical advice on where to find jade and gold, and what to do with them after you find them. The pair would look good in almost any rockhound's Christmas stocking.

LEAD ISOTOPES IN GEOLOGY. R. D. Russell, Associate Professor of Physics, University of British Columbia, and R. M. Farquhar, Asst. Professor of Physics, University of Toronto. Interscience Pub-

lishers, Inc. 1960. 243 pp. $9.00.

This book is a monograph on the isotopes of common lead. Its value to the geologist and geophysicist lies in the fact that variations in the isotopic composition of many of the common elements reflect the geological histories of the rocks and minerals of which the elements are constituents.

The contents cover such subjects as measurement of lead isotope ratios, the age of the earth, dating galenas by means of their isotopic constitutions, and lead-uranium-thorium methods of age determination. Case histories are presented for Canadian and Australian areas.

Several hundred isotopic analyses of common leads from many different countries including the United States are contained in an appendix. Facilities of the Computation Centre of the University of Toronto were made available to the authors during preparation of this work.

A PRIMER ON WATER, by Leopold and Langbein. Published by the United States Geological Survey, Department of Interior, Washington 25, D.C. 1960. 50 pp. Price 35¢.

General knowledge concerning our water supply, present and future, for the various geographic regions of the United States is fast becoming essential information for the continued wellbeing of our country. To help meet this heightened interest in water and its use and control is the reason this primer was written.

The primer is in two parts. The first part tells about hydrology, or the science that concerns the relation of water to our earth, and the second part describes the development of water supplies and the use of water.

The Survey is publishing this primer in nontechnical language in the hope that it will enable the general reader to understand the facts about water as a part of nature, and that by having this understanding the people will be better able to solve their water problems.

The text material is well illustrated with many excellent drawings and statistical tables, closing with a well selected glossary of terms commonly employed in the primer, which broadens its scope and usefulness as a teaching aid and for library use, both for the student and the instructor as well.

* * * *

The TOPAZ of Ethiopia shall not equal it, neither shall it be valued with pure gold. *Job 28:19*

BELIEFS, SUPERSTITIONS, AND FACTS ABOUT THE BIRTHSTONES. E. P. Van Leuven, 1998 Fixlini St., San Luis Obispo, Calif. 56 pp. 1960. 50¢.

Throughout his long history man has revered beautiful gemstones and ascribed various supernatural powers to them. Josephus, writing in the first century, proclaimed a connection between the 12 stones in the High Priest's breastplate and the 12 months of the year. This is believed to be the origin of the adoption of a "birthstone" by those born in each of the 12 months. The benefits conferred by their natal month gemstone are claimed to be particularly applicable to them.

Mr. Van Leuven has assembled a fascinating collection of lore concerning the 12 birthstones (garnet, amethyst, bloodstone, diamond, emerald, pearl, ruby, sardonyx, sapphire, opal, topaz, and turquoise) accepted by the National Association of Jewelers as official. Besides the almost universal attribute of warding off the evil-eye, these stones are said to have specific virtues also. The magnetic force in a sapphire could draw poison out of a boil, for example. Nero looked at gladiatorial combats through emerald sun-glasses to relieve the strain on his eyes. Pericles, the brilliant Greek administrator, depended on his pearl amulet to help him make wise decisions.

Nearly every mineral show these days exhibits a map in which a state or other geographical area is carved from an indigenous mineral. We learn from Mr. Van Leuven that the Persians thought this up a long time ago. In the palace at Teheran is a large globe on which every country in the world is shown in its native gemstone.

Other Societies

GEM CUTTERS GUILD OF BALTIMORE made a very successful field trip on Sept. 25 to Wrightsville, Pa. for pyrite. The club warns that a small minority of rockhounds have become "rock hogs" and are causing good collecting areas to be barred to all rockhounds. Rock hogs go to collecting areas in advance of regular club sponsored trips and load down their cars with more rocks than they can ever use or trade, and furthermore, they abuse the privileges granted by the owners of locations by disobeying rules.

COLORADO MINERAL SOCIETY held its annual exhibit of gems, minerals, fossils and Indian artifacts at the Jefferson County Fair on Aug. 10-14. An innovation was a special competitive exhibit category for dealers only.

NORWALK GEM AND MINERAL ASSOCIATION reports that its president, H. P. Gavan, has added a piece of fossil coal to his collection which predates all known fossils in the world by more than 500,000,000 years. It is known as pre-Cambrian coal.

HEART OF AMERICA GEOLOGY CLUB opened its fall season with a brag-session and the installation of its new officers. The club is making a "grab-bag" a permanent feature of all of its meetings.

OREGON AGATE AND MINERAL SOCIETY had its curiosity about kona dolomite satisfied at its September meeting, when John Mihelcic placed specimens of this scenic cutting material on the club's brag table and described its properties. A sad foot note to the kona dolomite story comes from the Ishpeming Rock and Mineral Society which reports that the quarry, in which kona dolomite is found, has been closed to collectors because many gem and mineral hobbyists abused the collecting privileges granted by the owners.

RECOMMENDED READING

"Let's Collect Fossils," by Gertrude Hannen, April issue of *The Pick & Dop Stick*. A beginner's guide to fossil collecting by the Chairman of the Midwest Federation's Paleontology Division. Contains many good tips for the novice.

"A Visit to the Crater of Diamonds," by Jose Engel. October issue of *Conglomerate*. The next best thing to visiting the Crater of Diamonds in Arkansas is reading Mr. Engel's account of his visit. The average person will learn more about the Crater of Diamonds from this fact-filled article than they will by visiting the crater.

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, JULY 2, 1946 AND JUNE 11, 1960 (74 STAT. 208) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF Earth Science, published bi-monthly at Mount Morris, Illinois for December, 1960. 1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher Earth Science Publishing Company, Inc., L.B.1357, Chicago, Ill.; Editor Ben Hur Wilson, 406 Grover Street, Joliet, Illinois; Managing editor William H. Allaway, 4729 Prince Street, Downers Grove, Ill.; Business manager J. Daniel Willems, 29 So. LaSalle St., Chicago, Illinois. 2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.) Ben Hur Wilson, 406 Grover St., Joliet, Illinois; William H. Allaway, 4729 Prince St., Downers Grove, Ill.; J. Daniel Willems, 29 So. LaSalle St., Chicago, Illinois; Earl D. Cornwell, 5426 Carpenter, Downers Grove, Ill. 3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None. 4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner. 5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required by the act of June 11, 1960 to be included in all statements regardless of frequency of issue.) 3000. Ben H. Wilson, editor.

Sworn to and subscribed before me this 10th day of October, 1960.

[SEAL] Mary M. Low, Notary Public

(My commission expires June 16, 1963.)

"And God said, let there be lights in the firmanent of the Heavens to divide the day from the night; and let them be for signs, and for seasons, and for days, and years."

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Greece, although a small country, possesses much potential mineral wealth. Her mines, however, were almost wholly destroyed during German occupation, and mining, it seems, has been the slowest of all her industries to recover.

Among the ores found in sufficiently large deposits to make mining profitable are bauxite (aluminum ore), pyrite, lead and zinc concentrates, barite, chrome, iron, magnesite, manganese, and antimony. Many new mine shafts are now under construction, and no doubt will soon be in operation.

While there may be deposits of oil, little or no effort has as yet been made by major oil companies to exploit them, due largely to the unfavorable mineral laws of the country. Lack of natural fuel has greatly retarded industrial development. United States engineers have been trying to remedy this situation as much as possible by making use of lignite deposits which are available in large quantities.

At Aliveri, 37 air miles from Athens, a thermal electric generating plant is being built over these deposits of lignite. No hard coal is to be found in Greece, but there are lignite deposits estimated up to 20 billion tons. This and hydroelectric developments now under construction may materially aid the economic structure of the country, saving foreign exchange now spent annually to import more than one half million tons of liquid fuel to supply her domestic and industrial needs.

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February issue ad deadline is December 10th!

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Through affiliation with the Midwest comes the opportunity to participate in our Annual Conventions, Rockramas, bulletin exchange programs, and receive information from our committees on each branch of the Earth Sciences.

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The Midwest comprises approximately 100 clubs and many individuals, and is a branch of the larger American Federation which comprises the regional Federations of the U. S. and Canada.

For further details, contact Richard N. Lake, P.O. Box 361, Chisholm, Minnesota.

EARTH SCIENCE, *Official Magazine*

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